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Spatio-Temporal Study of Road Traffic Crash on a National highway of bangladesh

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Abstract

Road traffic crashes (RTC) have now become a great social alarm in Bangladesh and the situation is deteriorating day by day. The road infrastructure of this nation is not standard and compatible with the rapid growth of urbanization and motorization. Which is why, the dimension of this problem is too challenging to solve. Though crashes do not show any regular pattern, but scientific research can reveal some common phenomenon like location, time and collision type and so on. The best option for a country to address the road crash is making the whole route safe by providing all required measures. But for a developing country like Bangladesh where investment comes on the basis of priority cannot manage those entire standards. In this situation characteristic analysis and black spot identification would be a compromised way to ensure road safety. The methodology of this study incorporates a framework on the basis of spatial-temporal study to identify most RTC occurrence locations or hazardous road locations by using kernel density (KDE) tool of Arc GIS. In this study, an essential and economic corridor like Dhaka to Sylhet national expressway has been connected the technique. This examination suggests that KDE technique for distinguishing proof of Hazardous Road Location (HRL) could be utilized for all other national roadways in Bangladesh and furthermore for other creating nations. Proposals have been recommended for policy maker to lessen RTC in Dhaka-Sylhet particularly in black spots.

Keywords: *Road crash; GIS; hazardous road location*

INTRODUCTION

According to the World report on road traffic injury prevention (2004), worldwide, an estimated 1.2 million people are killed in road accidents each year and as many as 50 million are injured [1]. In addition to these deaths, between 20 million and 50 million people globally are estimated to be injured or disabled every year. Around 88 percent of those deaths occur in the developing world [2], despite the fact that these nations represent 32 percent of the aggregate engine vehicle armada overall [3]. Around 15 percent of worldwide street fatalities were youngsters (0-14) of which 97 percent happened in low-salary and center wage nations. For each passing, there are far more noteworthy quantities of wounds four people with serious/changeless inabilities, ten people requiring healing center confirmation, and thirty people requiring crisis room treatment. Projections demonstrate that these figures will increment by around 65 percent throughout the following 20 years unless there is another sense of duty regarding counteractive action.

Bangladesh has 20,947.73 km of the aggregate street length, it incorporates national parkway, 3544.06 km, 4278.07

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km of territorial thruway and 13.247.79 km of area street [4]. In 2010, 37 percent of aggregate accidents happened on national interstates, 12 percent in territorial streets and 15 percent in feeder streets. The accidents are exceptionally bunched at a few areas. In the rustic regions around 43 percent of revealed national interstate accidents happened in just 5 percent length of national roadways. Almost 70% of street fatalities happened on rustic segments of the principle roadways as the metropolitan urban areas represented just around 20 percent [5].

There is a dire need and degree for enhancing the street wellbeing circumstance and for that matter, there is clearly requirement for much exertion and interest in security measures to alter the course. ID and treatment of most crash inclined areas would be a superior approach to lessen the number and seriousness of accidents. In this paper, an endeavor is made to actualize the GIS based accident examination framework to find the accident inclined areas on Dhaka-Sylhet national roadway in Bangladesh.

In particular, this includes plotting singular accident areas, recognizing accident-inclined zones utilizing portion thickness spatial investigation devices, and speaking to a determination of accident qualities of various sorts of these high accident areas. Here, accident data are collected from the Accident Research Institute (ARI), BUET. The specific objectives of this study are to determine the HRL on this route using GIS and to recommend some important measures for improvement.

Study area and data collection

Bangladesh has 8 national highways with the connection of universal interstate. Dhaka is the capital of and Sylhet is the port city in this nation and the interfacing course of both spots, Dhaka-Sylhet, is the most crash inclined and this review has been carried on this.

Crash data for a long time (2010 – 2012) has been gathered from the database of the Accident Research Institute (ARI), Bangladesh University of Engineering and Technology (BUET) and these crash data were amassed from police Accident Report Form (ARF). The factors like crash area, date, time, crash sort, crash seriousness, climate condition and number of lethal and non-deadly crash, area sorts were the primary crash particulates for the present study.

METHODOLOGY

To address the sufferings and the power of street crashes, a few projects and strategies have been taken by the specialist. Be that as it may, these projects and customary techniques have a few confinements. The exact area of accidents is frequently miss-coded wrongly, road names spelt, road number code might be wrongly coded. Facilitate troubles incorporate the absence of a typical referencing framework, absence of thought of the spatial investigation and are work serious and tedious [6].

All these make the recognizable proof of the high crash street area more troublesome, particularly for the customary electronic projects now being used. These could likewise prompt the wrong area of streets being recognized as risky if not the wrongly coded accidents are distinguished on time.

GIS is observed to be appropriate for such examination and ready to defeat *these impediments*. It has the ability to coordinate data from different sources and produce helpful data whereupon trustworthy choice can be based. Data in GIS framework for street wellbeing change are by and large put away in isolated topical layers. Each layer speaks to the subject of the general framework and contains spatial data and non-spatial

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data put away in the framework database, and at some point assistant records [7].
All these are connected together to build up of georeferenced database. The second period of the framework investigation concentrated on the utilization, remaking, and openness to different data components. This procedure made it conceivable to actualize the vast majority of the inquiries in a basic and fast way, where just a "microtype" investigation does the framework need to choose the data contained in the helper records. For this kind of spatial examination, there are a few diagnostic apparatuses accessible in GIS for crash dark spot distinguishing proof. Portion thickness estimation instruments are accessible in Arc GIS tool compartment. Piece thickness estimation apparatus is utilized to recognize HRL on Dhaka-Sylhet expressway. Street crash data have been gathered from crash examination bundle MAAP (Microcomputer crash investigation bundle). To demonstrate the said considers and accomplish the coveted outcome, a well ordered method as given underneath has embraced.

Map preparation:
Dhaka to Sylhet (N1) route has been created from the Google Earth Pro Image. The other road segments were collected from digitized maps.

Creation of crash data table
All the Crash event data (2010, 2011 and 2012) that are collected from the Accident Research Institute (ARI) are entered with the help of SPSS and MS excel. Some correction was done like, the location measurement converted from Km to meter. Other crash attributes like date, time, days are modified from the collected data. That table jointed with the route shape file.

Route creation
Local Government Engineering Department (LGED) district transport map was collected from the Local Government Engineering Department website. They are geo-referenced via Arc-GIS10.0. Then the route is drawn with the help of editing tool. Spatial adjustment is used to correct these routes.

To identify the crash prone location, the minimum section length was 0.1 Km with greatest length of 0.5 Km where there were 3 or more fatal crashes in the period of three years (2010-2012), were considered as hazardous locations. Upon further analysis, adjacent locations (within 3 km) with a fairly high number of crashes and consistent geometric features were aggregated in one hazardous location.

CRASH DATA ANALYSIS AND RESULT

The data analysis is done with spatial and statistical analysis for crash hotspot identification through various crash characters.

A Statistical analysis

The statistical analysis was confined to both SPSS and MS Excel. The various crash parameters and comparison were discussed in the study using bar graph, pie chart, table etc.

B Fatality rate

Dhaka-Sylhet Highway, in 2010 there were 48 percent death reported by the ARI database but in 2011 and 2012 the fatalities were respectively 12 and 40 percent. Fig.1 shows that, the number of passenger fatality is comparatively higher than driver and pedestrian fatalities with large margin. Driver death during RTC event is increased from 2010 to 2012 and the rate are 46, 16, and 38 percent.

Number of passenger deaths aredecreasing from 2010 to 2012 and fatality rates are around 53, 20, and 27 percent. Pedestrian's fatality (from 2010 to 2012) is decreasing in number.

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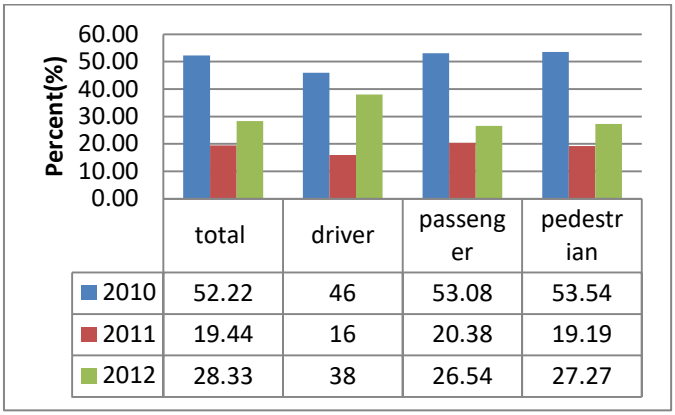

Fig1:*Fatality rate of Dhaka-Sylhet Highway*

C RTC by months

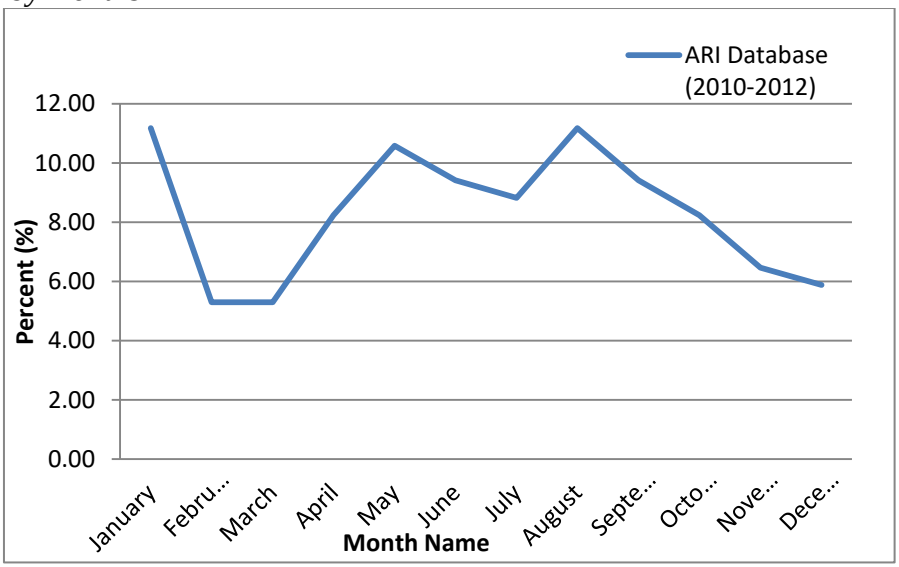

Fig 2. *RTC by Month in Dhaka-Sylhet Highway*

In Dhaka-Sylhet Highway; January, May and August are the highest RTC event occurrence month during 2010 to 2012, the percentage are 11.1, 10.7 and 11.1 respectively.

D Seasonal variation of RTC

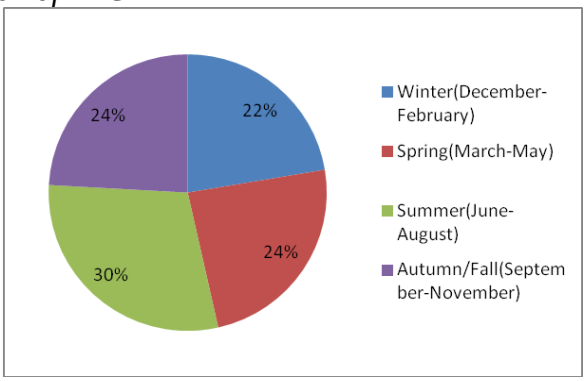

Fig. 3. *Seasonal variation of RTA in Dhaka-Sylhet highway*

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Fig. 3 shows that, there is a close balance in the seasonal variation of RTC in Dhaka-Sylhet national highway and 30% RTC event occurred in summer season-is the highest.

E Temporal variation of RTC

Figure 4 illustrates that, RTC rate is high in working hour of this route. In the working hour the concentration of pedestrians and vehicle are high on the highway. In Dhaka-Sylhet highway, during daylights (6.00AM-6.00PM) percentage of crash is 64.

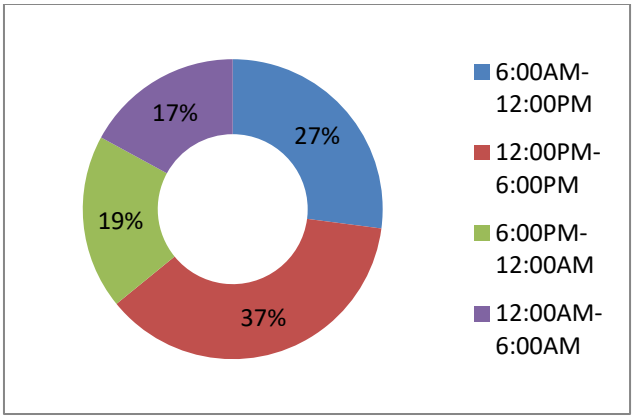

***Fig. 4** Temporal variation of RTA in Dhaka-Sylhet highway*

F RTA by types of collision

Types of collision represent that 'Hit pedestrian' are the dominant RTC type. About 43% of total RTC were pedestrian related in last 3 years. 'Head on collision' is in 2nd position of RTC type, 31.76% of the total RTC were of this type. Other common crash types are: rare end 14.12%), hit vehicle (4.12%) and side swipe (6.76%).

***TABLE 1.** TYPE OF COLLISION IN DHAKA-SYLHET HIGHWAY HIGHWAY.*

Type of Collision	Dhaka-Sylhet Highway	Percent
Head on	54	31.76
Rear end	24	14.12
Right Angle	0	0.00
Side swipe	2	1.18
Over Turn	5	2.94
Hit object on Road	0	0.00
Hit object off road	1	0.59
Hit standing vehicle	7	4.12
Hit Pedestrians	73	42.94
Hit animal	0	0.00
Others	4	2.35
Total	170	100

G RTC severity

Severities of RTC events are classified for this study as fatal, grievous, simple and motor crash. The table shows that the number of fatal RTA is high. At Dhaka-Sylhet highway statistics shows that, 144 events are fatal crashes out of 170 RTC.

***Table 2:**RTA severity type in Dhaka-Sylhet Highway*

Data Source	Fatal	Grievous	Simple injury	Motor crash	Total
ARI	144	22	3	1	170

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H Spatial analysis to identify HRL location

There are numerous measurable techniques that are accessible in Arc GIS 10.0, In this review Kernel thickness investigation instrument has been utilized to distinguish the Hazardous Road Location (HRL) of Dhaka-Sylhet Highway. For the density estimation technique, the aggregate deadly crash number has been measured as the influential value.

In Dhaka-Sylhet Highway as per ARI data (2013-2012), table (6.07 and 6.08) demonstrates that among the distinctive upazila in Narayanganj, Narsingdi, Brahmanbaria, Kishorganj, Habiganj, Moulavibazar and Sylhet, NarsingdiSadar is the most defenseless territory in this expressway. It contributes 73 losses in 26 RTA in the middle of year 2010 to 2012. Shibpur Upazila of Narsingdi locale another helpless zone, it contributes 42 setback's in 16 RAT amid the time of 2010 to 2012. To recognize HRL, Kernel thickness technique is connected considering the aggregate number of lethal crash and number of casualty in a specific RTC area. The Kernel thickness raster surface has been produced utilizing 50m cell estimate and 500m pursuit sweep. The evaluated portion esteem is then characterized into three classes with equivalent interim. Eight areas have been found at perilous on this course after this spatial examination and the force of their dangers likewise appeared on the guide. In table 3 the concise summery has been appeared, trailed by spatial maps.

Table 3: *RTA severity type in Dhaka-Sylhet Highway*

HRL	Location Name	KM Value	Fatalities	Dominant Collision Type
1	Tarabo, Rupgonj,	17	4	Hit Pedestrians
2	Rupshi, Rupgonj,	21	10	Over Turn
3	Son para	27	4	Hit Pedestrians
4	Bagh hata	47.9	9	Hit Pedestrians
5	Madhabdi Bus Stand	49	11	Head on
6	Narsingdi sadar, Narsingdi	49.5	19	Rear end
7	Kararchor, Shibpur	53	9	Head on
8	Etakhola, Shibpur	56.3	3	Hit Pedestrian
9	Kundar para, Shibpur	62	15	Head on
10	Sristygor, Shibpur,	67	9	Head On
11	Narayanpur busstand belabo	78	9	Head On
12	Mahmudabad, Raipura,	80	3	Hit Pedestrian
13	Asuganj Thanadia, Kariala	87	10	Head On
14	Old rail Gate Asugang	88.8	5	Hit Pedestrian
15	Old Sohagpur	92	6	Hit Object
16	Sonaram , Bharamnbariar	99	3	Hit Pedestrian
17	Bhamanbaria end	114	4	Hit Object
18	Bhamanbaria end	122	7	Head On

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Crash scenario has been shown in map below

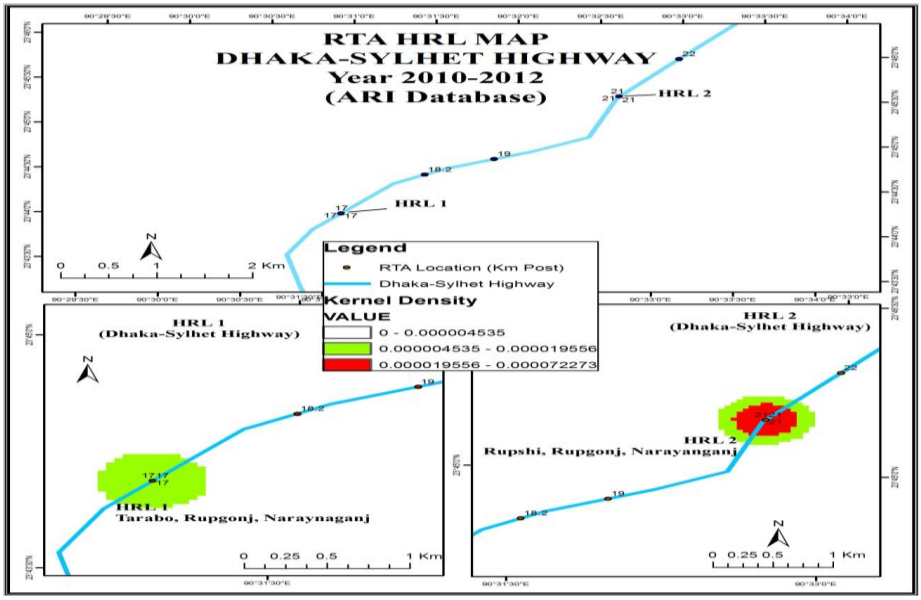

Fig. 5. *hazardous road locations (3 to 6) on the basis of KDE analysis*

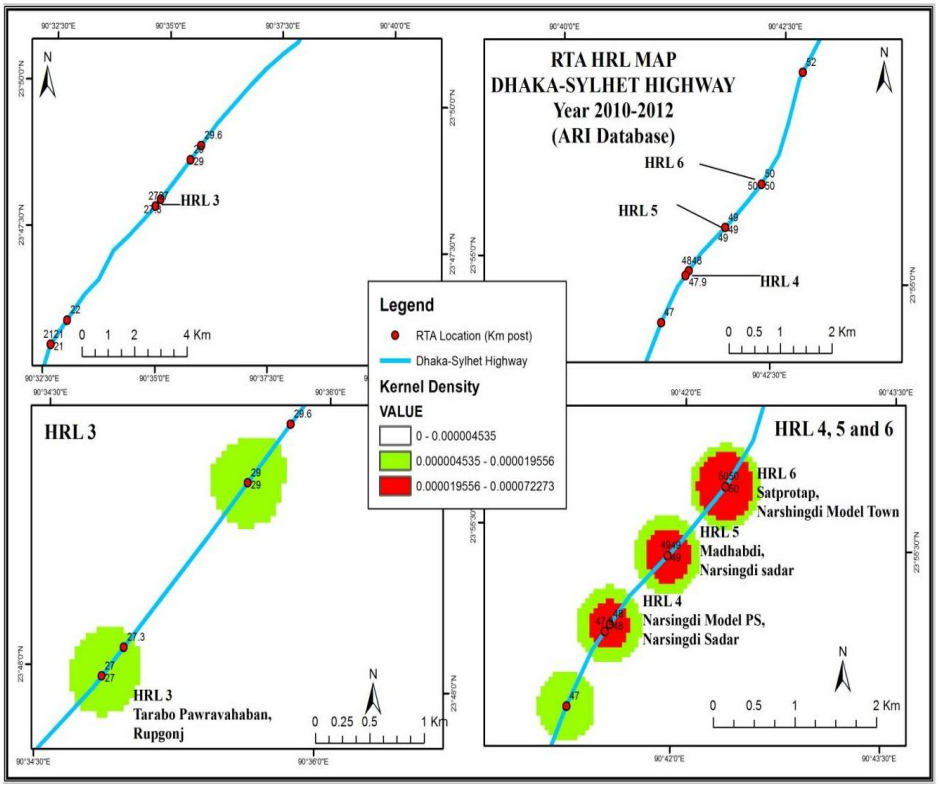

Fig 6.*hazardous road locations (1 to 2) on the basis of KDE analysis*

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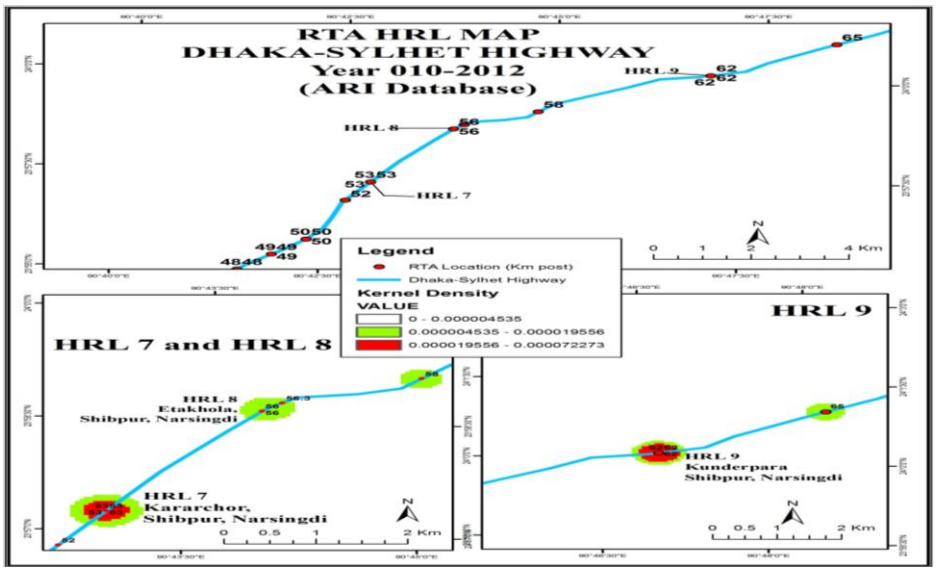

Fig. 7. *Hazardous road locations (7 to 9) on the basis of KDE analysis*

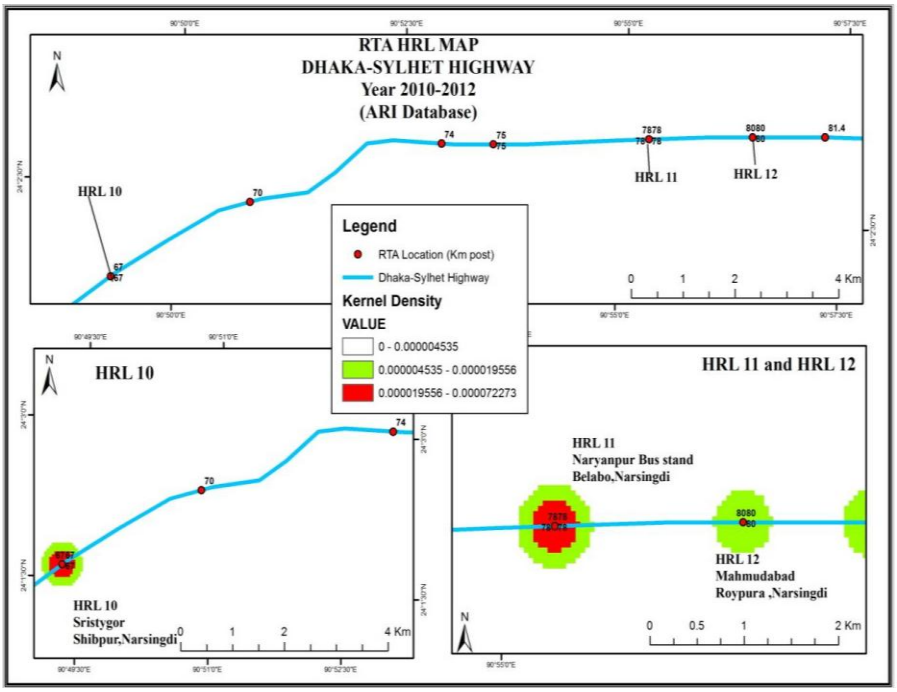

Fig.8. *Hazardous road locations (10 to 12) on the basis of KDE analysis*

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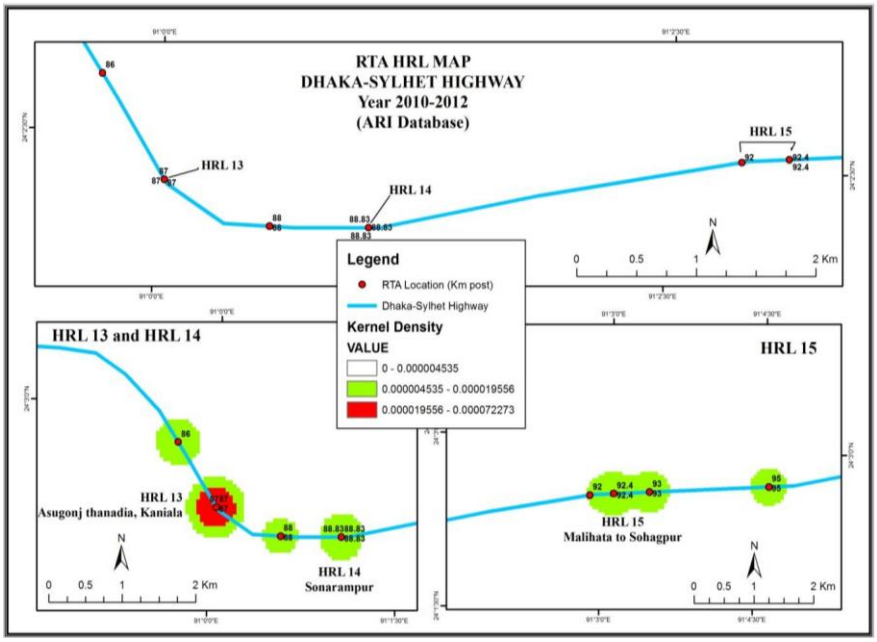

Fig. 9. *hazardous road locations (13 to 15) on the basis of KDE analysis*

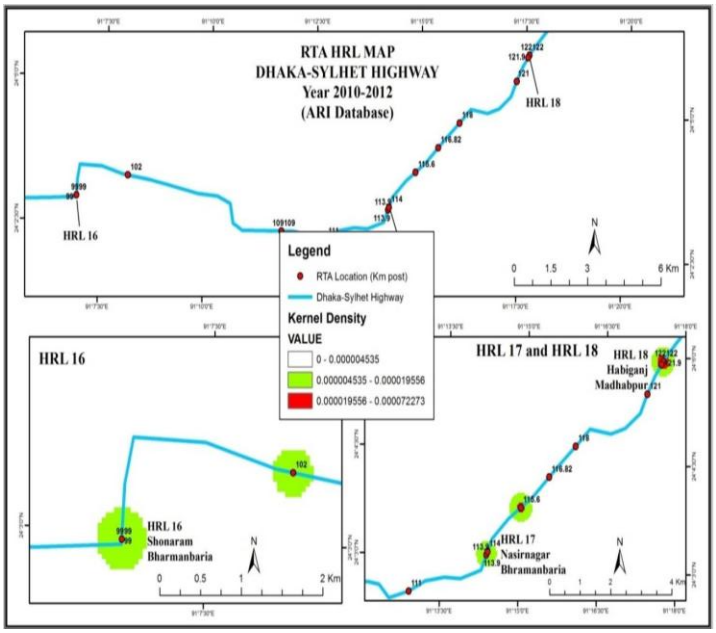

Fig. 10. *hazardous road locations (16 to 18) on the basis of KDE analysis*

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CONCLUSION AND RECOMMANDATION

This paper has highlighted the crash characteristics of a national roadway in Bangladesh and recognized the unsafe street areas. This kind of recognizable proof is the prime prerequisites for countermeasure choice and arrangement. Otherwise, appropriate measures will have proper measures will be applied in wrong locations.

The research found that, RTC number is high before the weekend. 'Head On is the overwhelming accident sort while 'Hit Pedestrian' is in second position of RTC. As per ARI database (2010-2012), there are 18 HRLs has found in Dhaka-Sylhet Highway.

There are many contributing elements that are in charge of RTC occasion in Dhaka-Sylhet parkway. The exploration result uncovers that speeding, thoughtless driving and walker activity are the most vital causes RTC of this course.

To decrease RTC in Dhaka-Sylhet, arrangement producers ought to consider the accompanying proposals:

- Head on crashes are likewise a matter of worry in these expressways. Unified expressway, heedless surpassing are the fundamental driver of head on impact. So separated parkway and uncommon surpassing segments ought to be given.
- Pedestrian is the most helpless gathering at all portions in this course. In this way, person on foot office such as passerby briar, bridge, underpass, zebra crossing, person on foot flag and so forth ought to be expanded. Likewise concentrate on speed diminishment close schools, the bazaar and private ought to be considered.
- Appropriate signs, street markings, fencing, guardrails, intersection adjustments, and enhancements to perceivability ought to be considered as a therapeutic measure.
- Dangerous and wrong operation of overwhelming vehicles (transports and trucks, for example, neglectful surpassing, over-burdening and braking/ceasing on streets and street sides are especially a difficult issue in every one of those portions. In this way, sufficient implementation ought to likewise be considered.
- Police ought to top off the ARF effectively that would help in logical research to locate the counter measures.
- The usage of 5E's (Engineering, Education, Enforcement, Environment and Evaluation) at street security is required.
- The extra street security methodology ought to be created by the experts that are connected with the Road wellbeing.
- The Development of Emergency reaction framework in Highway is direly required.
- Public investment in street security administration is required. In nearby legitimate level speculation to lessen RTC in Dhaka-Sylhet roadway could be an effective thought.
- Building mindfulness and awareness about driving and strolling out and about should be possible through electronic and print media.
- The government ought to make activity to apply GIS innovation and GIS investigator to enhance this situation of RTC.

The most surely understood therapeutic measures for street security change depend on building, instruction and authorization, which incorporate the extra suggested measures, specifically, nature and assessment. To guarantee street security the execution of 5E's is required.

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Condition and land utilize example is not same in each area which is the reason before apply any measures indepth ponder on financial review would be helpful.

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